

**DIVISION 300 -- BASE COURSES****SECTION 304 -- AGGREGATE BASE COURSE****Description**

**1.1** This work shall consist of furnishing and placing base courses on a previously prepared subgrade or course as shown on the plans or as ordered.

**1.2** This work shall also include raising the grade of the edge of the roadway shoulders with crushed aggregate as shown on the plans or as ordered to match the grade of the pavement course placed on the shoulders or to provide a base for shoulder pavement.

**Materials****2.1 General.**

**2.1.1** The materials shall consist of hard, durable particles or fragments of stone or gravel. Materials that break up when alternately frozen and thawed or wetted and dried shall not be used for aggregate base course materials. Fine particles shall consist of natural or processed sand. The materials shall be free of harmful amounts of organic material. Unless otherwise specified, the percent wear of base course material shall not exceed 50 percent as determined by AASHTO T 96, Grading A.

**2.1.2** Crushed stone and crushed ledge rock shall be processed material obtained from a source that has been stripped of all overburden. The processed material shall consist of clean, durable fragments of ledge rock of uniform quality and reasonably free of thin or elongated pieces.

**2.2 Gradation.** The required gradation of base course material shall conform to Table 1.

**2.3 Sand.** The maximum size of any stone or fragment shall not exceed three-fourths of the compacted depth of the layer being placed but in no case larger than 150 mm (6 in).

**2.4 Gravel.** The maximum size of stone particles shall not exceed three-fourths of the compacted thickness of the layer being placed but in no case larger than 150 mm (6 in).

**2.5 Crushed gravel.** At least 50 percent of the material retained on the 25.0 mm (1 in) sieve shall have a fractured face.

**2.5.1** When the quantity of crushed gravel in the contract is 4000 m<sup>3</sup> (5,000 yd<sup>3</sup>) or less, the fractured faces requirement and the gradation requirements for the 25.0 mm (1 in) sieve for crushed gravel may be waived to permit the use of modified crushed gravel. (See Table 1 for gradation.)

**Table 1 -- Base Course Materials (Metric)**

Required Gradation							
Item No.	304.1	304.2	304.3	304.3	304.33	304.4	304.5
Item	Sand	Gravel	Crushed Gravel	Modified Crushed Gravel	Crushed Aggregate For Shoulders	Crushed Stone (Fine)	Crushed Stone (Coarse)
Sieve Size	Percent Passing By Weight						
150 mm	100	100	---	---	---	---	---
125 mm	---	---	---	---	---	---	---
100 mm	---	---	---	---	---	---	---
90 mm	---	---	---	---	---	---	100
75 mm	---	---	100	100	---	---	85 – 100
50 mm	---	---	95 – 100	95 – 100	---	100	---
37.5 mm	---	---	---	---	100	85 – 100	60 – 90
25.0 mm	---	---	55 – 85	---	90 – 100	---	---
19.0 mm	---	---	---	---	---	45 – 75	40 – 70
4.75 mm	70 – 100	25 – 70	27 – 52	27 – 55	30 – 65	10 – 45	15 – 40
0.075 mm (In Sand Portion)*	0 – 12	0 – 12	0 – 12	0 – 12	---	---	---
0.075 mm (In Total Sample)	---	---	---	---	0 – 10	0 – 5	0 – 5

\* Fraction passing the 4.75 mm sieve

**Table 1E -- Base Course Materials (English)**

Required Gradation							
Item No.	304.1	304.2	304.3	304.3	304.33	304.4	304.5
Item	Sand	Gravel	Crushed Gravel	Modified Crushed Gravel	Crushed Aggregate For Shoulders	Crushed Stone (Fine)	Crushed Stone (Coarse)
Sieve Size	Percent Passing By Weight						
6 in	100	100	---	---	---	---	---
5 in	---	---	---	---	---	---	---
4 in	---	---	---	---	---	---	---
3-1/2 in	---	---	---	---	---	---	100
3 in	---	---	100	100	---	---	85 – 100
2 in	---	---	95 – 100	95 – 100	---	100	---
1-1/2 in	---	---	---	---	100	85 – 100	60 – 90
1 in	---	---	55 – 85	---	90 – 100	---	---
3/4 in	---	---	---	---	---	45 – 75	40 – 70
No. 4	70–100	25–70	27 – 52	27 – 55	30 – 65	10 – 45	15 – 40
No. 200 (In Sand Portion)*	0–12	0–12	0 – 12	0 – 12	---	---	---
No. 200 (In Total Sample)	---	---	---	---	0 – 10	0 – 5	0 – 5

\* Fraction passing the No. 4 sieve.

**2.6 Crushed gravel for shoulder leveling.** This material shall consist of crushed aggregate for shoulders meeting the gradation requirements of Table 1 and shall then be mixed with at least 25 percent by volume of loam meeting the requirement of 641.2.1.

**2.7 Crushed aggregate for shoulders.** This material shall meet the gradation requirements of Table 1.

**2.8 Gravel for drives.** The material shall meet the requirements of gravel as shown in Table 1.

**2.9 Crushed gravel for drives.** The material shall meet the gradation requirements of either crushed gravel or crushed stone (fine) as shown in Table 1.

**2.10 Crushed stone base course (fine gradation).** Acceptable sand may be blended as necessary to obtain the proper gradation for the fine aggregate portion.

**2.11 Crushed stone base course (coarse gradation).** Acceptable sand may be blended as necessary to obtain the proper gradation for the fine aggregate portion.

**2.11.1** The substitution of crushed stone meeting the requirements of crushed stone base course (fine gradation) for all or part of this item will be permitted.

### Construction Requirements

#### 3.1 General.

**3.1.1** Upon approval, base course materials found within the project limits may be used under the specific item in accordance with 104.08.

**3.1.2** Gravel may be substituted for any sand course. Crushed gravel may be substituted for gravel. Substitutions must be made across the entire section and will not be allowed for short or discontinuous segments.

**3.1.3** Crushed stone (fine gradation) may be substituted for crushed gravel provided there is a minimum of 0.3 m (1 ft.) of sand or gravel below the crushed stone. The substitution must be made across the entire section and will not be allowed for short or discontinuous segments.

**3.1.3.1** Also, permission may be granted to use reclaimed stabilized base in lieu of crushed gravel or crushed stone (fine gradation) provided the following requirements are met:

- (a) The material shall meet the requirements of 306.
- (b) The approved material shall be applied across the entire cross-section at a constant depth. Short or discontinuous sections as determined by the Engineer will not be allowed.
- (c) Transitions between reclaimed asphalt and crushed gravel or crushed stone (fine gradation) shall be made using a 15 m (50 ft) taper.
- (d) Reclaimed asphaltic material shall be placed directly under the proposed pavement.

**3.1.3.2** Also, permission may be granted to use reclaimed asphalt pavement blended with granular material meeting the requirements of 304 in lieu of crushed gravel or crushed stone base course (fine gradation) providing that the following requirements are met:

- (a) The material shall meet the gradation requirements of the material being replaced.
- (b) The approved material shall be applied across the entire cross-section at a constant depth. Short or discontinuous sections as determined by the Engineer will not be allowed.
- (c) Transitions between reclaimed asphalt and crushed gravel or crushed stone (fine gradation) shall be made using a 15 m (50 ft) taper.
- (d) This material shall be placed directly under the proposed pavement.

**3.1.4** Crushed aggregate base course materials shall be produced and placed in their final location with as little segregation as possible.

## **3.2 Aggregate Crushing Plant.**

**3.2.1** The equipment for producing crushed gravel shall be of adequate size and with sufficient adjustments to produce the required materials without unnecessary waste. The plant shall be capable of removing excess fines.

**3.2.2** The equipment for producing crushed stone and crushed ledge rock shall consist of sufficient units with sufficient adjustments to produce the required material. The plant shall be capable of removing undesirable material and excess fines. In order to meet the required gradation, the Contractor may produce acceptable material in one operation or combine coarse and fine piles through a proportioning hopper to create a combined stockpile.

## **3.3 Stockpile Construction.**

**3.3.1** All crushed aggregate base course materials shall be stockpiled. The Contractor shall give the Engineer advance notification of when the manufacturing and stockpiling is to begin.

**3.3.2** A stockpile of acceptable material, as described in 3.5, equal to at least 20 percent of the bid quantity or 4000 m<sup>3</sup> (5,000 yd<sup>3</sup>), whichever is less, shall be constructed before the hauling and placing phase of the work begins. The stockpile shall be maintained until approximately 80 percent of the quantity has been placed.

**3.3.3** Stockpiles shall be constructed in layers that minimize segregation. The desired optimum thickness of layers is 1.8 m (6 ft) and in no instance shall the layer be more than 3 m (10 ft). Each layer shall be completed before the next layer is started. Construction of stockpiles by direct use of a fixed conveyor belt system or by dumping over a bank will not be permitted.

## **3.4 Placing.**

**3.4.1** The subgrade or preceding course shall be shaped to the specified crown and grade and maintained in a smooth condition free of holes and ruts. If the hauling equipment causes ruts in the subgrade or previously placed base course, the equipment shall be operated only on the course being placed, behind the spreading equipment.

**3.4.2** Care shall be taken to avoid segregation during placement. When base course material is dumped in piles, it shall be dumped on the course being placed and spread at once onto the previously placed layer. If spreading equipment is not available, dumping will not be permitted. Any segregation that occurs shall be remedied or the materials removed and replaced at no additional cost to the Department.

**3.4.3** The Contractor's method of operation shall be such that oversized stones will not be delivered to the project.

**3.4.4** When the base course is to be surface-treated and no pavement is to be placed upon it, stones having any dimension greater than 75 mm (3 in) shall be removed from the upper 100 mm (4 in) of the top layer.

**3.4.5** Prior to fine grading, hard spots in the surface of the top layer shall be eliminated by scarifying the top 100 mm (4 in).

**3.4.6** Crushed gravel for shoulder leveling shall be spread uniformly along the area adjoining the edge of the pavement. The material shall be spread along both sides of guardrail where there is no curb.

**3.4.7** To prevent segregation of crushed aggregate during spreading and to assist in obtaining the required density of the mixture, water may be added to the crushed aggregate prior to performing the grading operations. The course shall be maintained in the moist condition during grading operations.

**3.4.8** Crushed aggregate shall be hauled from an approved stockpile. Material obtained directly from a conveyor shall not be placed on the roadway without first stockpiling.

**3.4.9** The base course material shall be spread in the amount necessary for proper consolidation and shall be shaped true to grade and cross-section by means of power graders or other approved equipment.

**3.4.10** Surface voids in crushed stone base course (fine gradation) shall be eliminated by the addition of filler material to just fill the voids. Any surplus filler material shall be removed. The finished surface shall be uniform, true to grade, and free from segregation. The Contractor shall furnish and place filler material to correct any visible segregation prior to paving. The filler material shall be spread, scarified, if required, into the course, and recompact to the required density. Filler material shall meet the gradation requirements of sand. The final gradation of crushed stone base course (fine gradation) shall meet the requirements of Table 1.

### **3.5 Testing For Gradation.**

**3.5.1** Sampling procedure shall conform to AASHTO T 2. Testing procedures shall be in accordance with AASHTO T 27.

**3.5.1.1** When reclaimed asphalt pavement is blended with granular material to be used in lieu of crushed gravel or crushed stone base course (fine gradation) the method used to determine the amount of coarse material shall be determined according to NHDOT S-1.

**3.5.2** The amount of material finer than the 0.075 mm (No. 200) sieve shall be determined according to AASHTO T 11, which specifies dry sieving after washing.

**3.5.2.1** When reclaimed asphalt pavement is blended with granular material to be used in lieu of crushed gravel or crushed stone base course (fine gradation) the method used to determine

the amount of material finer than the 0.075 mm (No. 200) sieve shall be determined according to NHDOT S-1.

**3.5.3** For a preliminary determination of compliance with the specification for gradation, samples of sand and gravel may be taken from the pit, and samples of crushed gravel and crushed aggregate may be taken from the stockpile or from the final phase of the crushing operation. Materials not meeting the gradation requirements shall not be placed on the roadway

**3.5.4** Samples for acceptance testing of the material in place will be taken from each lift. Sampling for acceptance testing will not be done until the material has been graded and compacted.

**3.5.5.** Previously tested and accepted material contaminated by earthen, organic, or other foreign matter or degraded by hauling equipment to such an extent that the material no longer meets the gradation requirements shall be removed and replaced or otherwise made acceptable at the Contractor's expense.

### **3.6 Compaction.**

**3.6.1** Unless shown on the plans or ordered otherwise, the compacted depth of sand courses shall not exceed 300 mm (12 in). The compacted depth of any layer of gravel, crushed gravel, or crushed stone placed shall not exceed 200 mm (8 in). The compacted depth of any layer of crushed ledge rock shall not exceed 600 mm (24 in).

**3.6.2** Compaction of base course material shall be done with approved vibratory rollers and adequate water to meet the requirements of 3.7. A roller producing a dynamic force of at least 120 kN (27,000 lb) shall be used for layers up to 300 mm (12 in). For layers between 300 and 600 mm (12 and 24 in), the roller shall produce a dynamic force of at least 187 kN (42,000 lb). Rolling and shaping shall continue until the required density is attained.

**3.6.3** Rolling and shaping patterns shall begin on the lower side and progress to the higher side of the course while lapping the roller passes parallel to the centerline. Rolling and shaping shall continue until each layer conforms to the required grade and cross-section and the surface is smooth and uniform.

**3.6.4** Water shall be uniformly applied over the base course materials during compaction in the amount necessary for proper consolidation.

**3.6.5** When vibratory equipment is being operated, the amplitude of vibrations shall be adjusted as necessary to avoid causing damage to adjacent buildings and property.

**3.6.6** Except at inaccessible locations, such as guardrail, material used for shoulder leveling shall be set with a pneumatic-tired roller.

### **3.7 Density Testing.**

**3.7.1** The density of sand courses shall be determined by AASHTO T 191 (Sand-Cone Method), AASHTO T 204 (Drive Cylinder Method), or AASHTO T 238 (Nuclear Methods).

The density shall not be less than 95 percent of the maximum density determined in accordance with AASHTO T 99 (Standard Proctor Test) or a control strip. (See 3.8.)

**3.7.2** The density of gravel and crushed gravel courses shall be determined by AASHTO T 191 (Sand-Cone Method) or AASHTO T 238 (Nuclear Methods). The density of crushed stone base courses shall be determined by AASHTO T 238 (Nuclear Methods). The density shall not be less than 95 percent of the maximum density as determined by AASHTO T 99 (Standard Proctor Test) or a control strip. (See 3.8.)

### **3.8 Control Strip Procedure.**

**3.8.1** At the beginning of the compaction operation a control strip of at least 30 m (100 linear ft) in length and spanning the width of the section being placed shall be constructed. The density requirement shall be determined by compacting the control strip at a suitable moisture content until no further increase in density can be measured. The remainder of the course shall be compacted to a density not less than 95 percent of the maximum control strip density, as measured by the nuclear density testing equipment. A new control strip will be required when there is a significant change in the gradation of the material being placed or a change in compaction equipment. Compaction of the control strip shall be done with approved vibratory rollers or compactors capable of producing a dynamic force of at least 120 kN (27,000 lb).

### **3.9 Winter Construction.**

**3.9.1** Base course materials shall not be placed on or above frozen material if the depth from the top of the contemplated course to the bottom of the frozen material exceeds 750 mm (2-1/2 ft).

**3.9.2** If the density requirements are not attained for any layer before the material freezes, no further material shall be placed on that layer.

### **Method of Measurement**

**4.1** Roadbed base course materials of sand, gravel, crushed gravel, crushed aggregate for shoulders, crushed stone (fine gradation), and crushed stone (coarse gradation) will not be measured, but shall be the cubic meter (cubic yard) final pay quantity in accordance with 109.11 of compacted material required within the lines shown on the plans.

**4.1.1** Adequate measurements of the excavated asphalt used to replace crushed gravel or crushed stone (fine gradation) will be made to adjust the quantity from the pit total used to determine total borrow as required in 203.4.3.

**4.2** Applicable provisions for borrow pits as stated in 106.02 shall apply to base course materials.

**4.3** Crushed gravel for shoulder leveling will be measured by the cubic meter (cubic yard) determined by using 80 percent of the loose volume of material measured in vehicles in accordance with 109.01.



**4.4** Gravel and crushed gravel for drives will be measured by the cubic meter (cubic yard) of compacted materials placed within the limits shown on the plans.

### **Basis of Payment**

**5.1** Roadbed base course materials of sand, gravel, crushed gravel, crushed aggregate for shoulders, crushed stone (fine gradation), and crushed stone (coarse gradation) are final pay quantities and will be paid for at the contract unit price per cubic meter (cubic yard) in accordance with 109.11.

**5.1.1** Reclaimed stabilized base authorized for use in lieu of crushed gravel or crushed stone (fine gradation) will be paid for as provided as provided in 5.1

**5.2** Filler material used to eliminate voids in crushed stone base course (fine gradation) will be subsidiary.

**5.3** The accepted quantities of gravel or crushed gravel or both for drives and crushed gravel for shoulder leveling will be paid for at the contract unit price per cubic meter (cubic yard) complete in place.

### **Pay items and units:**

304.1	Sand (F)	Cubic Meter (Cubic Yard)
304.2	Gravel (F)	Cubic Meter (Cubic Yard)
304.25	Gravel for Drives	Cubic Meter (Cubic Yard)
304.3	Crushed Gravel (F)	Cubic Meter (Cubic Yard)
304.32	Crushed Gravel for Shoulder Leveling	Cubic Meter (Cubic Yard)
304.33	Crushed Aggregate for Shoulders (F)	Cubic Meter (Cubic Yard)
304.35	Crushed Gravel for Drives	Cubic Meter (Cubic Yard)
304.4	Crushed Stone (Fine Gradation) (F)	Cubic Meter (Cubic Yard)
304.5	Crushed Stone (Coarse Gradation) (F)	Cubic Meter (Cubic Yard)
304.6	Crushed Ledge Rock	Cubic Meter (Cubic Yard)

**SECTION 306 -- RECLAIMED STABILIZED BASE****Description**

**1.1** This work shall consist of scarifying, if necessary, and pulverizing the existing pavement together with a base course material. It may require removal and rehandling and the addition of other materials as shown on the plans or as ordered.

**Materials****2.1 General.**

**2.1.1** The material shall consist of the existing pavement blended with the underlying gravel or additional stone as required. Reclaimed stabilized base shall have a minimum bitumen content of 1.5 percent and conform to the following gradation:

Sieve Size	Percent Passing By Weight
75 mm (3 in)	100
37.5 mm (1-1/2 in)	80 - 100
19.0 mm (3/4 in)	55 - 90
4.75 mm (No. 4)	40 - 70
0.075 mm (No. 200)	3 - 10 "Total Sample"

**2.1.2** Additional stone as required to meet the above gradation shall meet the requirements of 304.2.1.1 with a maximum size of 37.5 mm (1-1/2 in).

**2.1.3** Additional asphalt shall meet the requirements of 702, as specified.

**Construction Requirements**

**3.1** The existing pavement shall be pulverized together with the underlying base course or additional crushed gravel. The pulverizing operation shall blend the existing pavement and base course into a homogeneous mass, using the bitumen contained in the pavement as a stabilizer. The quantity of material mixed with the existing pavement shall be adjusted as necessary to meet the material specification of 2.1.1.

**3.2** The reclaimed stabilized base shall be processed, using scarifying equipment and a traveling hammermill or other approved reclaimers. Equipment such as a milling machine or a rock crushing plant will not be permitted. Reclaiming equipment shall be equipped with a gauge to show depth of material being processed.

**3.3** Water shall be applied, as ordered, for the purpose of dust control and to ensure proper compaction. Water may be added during fine grading to improve workability. Additional water shall be applied prior to compaction and may require mixing to blend with reclaimed material to insure adequate compaction.

**3.4** Compaction shall be accomplished by successive passes of a vibratory sheep's foot or pad foot roller of at least 222 kN (50,000 lb) of dynamic force. Final rolling shall be accomplished by a smooth steel wheel vibratory roller of at least 120 kN (27,000 lb) of dynamic force. Density testing shall conform to 304.3.8.

**3.5** Gradation and bitumen content shall be determined by AASHTO T 164. Gradation shall be determined on the total sample prior to extraction. Bitumen content shall be determined on that portion of the sample which passes a 19 mm (3/4 in) sieve. The Contractor shall make provisions for an appropriate testing facility for Department personnel to perform the test, AASHTO T 164, as needed.

**3.6** Prior to placing the processed material, the roadbed shall be shaped to the specified crown and grade. If the existing roadbed is disturbed, it shall be compacted in accordance with 304.3.6.

**3.7** Excess material, unless specified otherwise, shall become the property of the Contractor.

**3.8** Care shall be exercised to save all pavement for reclaiming if trenches are constructed prior to processing.

**3.9** If the reclaimed stabilized base is not sufficient to complete the project, additional crushed gravel shall be used to make up the deficiency.

**3.10** Reclaimed stabilized base specified to be removed and rehandled may be processed in the roadway or off site. The reclaimed stabilized base shall be returned to the highway and placed on the prepared roadbed to the depths specified.

**3.11** Additional asphalt may be required to obtain the minimum 3 percent bitumen content.

**3.11.1** The asphalt shall be applied by a liquid distributor or other approved method, at a rate specified by the Engineer. The asphalt shall be blended with the reclaimed stabilized base using approved mixing equipment.

**3.11.2** Asphalt shall not be applied when rain is threatening, during rain storms, or when the air temperature is below 10 °C (50 °F).

**3.11.3** Prior to the addition of asphalt, the moisture content of the reclaimed stabilized base shall be adjusted by aerating or adding water if required.

**3.12** If additional stone is used it shall be blended with the reclaimed material using an approved reclaimer.

### Method of Measurement

**4.1** Reclaimed stabilized base, of the depth specified will not be measured, but shall be the square meter (square yard) final pay quantity for material within the limits shown on the plans.

**4.2** Additional stone will be measured by the metric ton (ton) in accordance with 109.01.

**4.3** Asphalt will be measured by the metric ton or kilogram (ton or pound) in accordance with 109.01.

### Basis of Payment

**5.1** Reclaimed stabilized base, of the depth specified is a final pay quantity item and will be paid for at the contract unit price per square meter (square yard), complete in place in accordance with 109.11.

**5.1.1** Removal and rehandling or removal of excess material shall be subsidiary to reclaimed stabilized base.

**5.2** The accepted quantity of stone will be paid for at the contract unit price per metric ton (ton), complete in place.

**5.3** The accepted quantities of asphalt will be paid for at the contract unit price per metric ton or kilogram (ton or pound), complete in place.

### Pay items and units (Metric):

306.115	Reclaimed Stabilized Base Processed in Place, 150 mm Deep (F)	Square Meter
306.120	Reclaimed Stabilized Base Processed in Place, 200 mm Deep (F)	Square Meter
306.125	Reclaimed Stabilized Base Processed in Place, 250 mm Deep (F)	Square Meter
306.215	Reclaimed Stabilized Base Removed and Rehandled, 150 mm Deep (F)	Square Meter
306.220	Reclaimed Stabilized Base Removed and Rehandled, 200 mm Deep (F)	Square Meter
306.225	Reclaimed Stabilized Base Removed and Rehandled, 250 mm Deep (F)	Square Meter
306.31	Asphalt For Reclaimed Stabilized Base	Kilogram
306.32	Asphalt For Reclaimed Stabilized Base	Metric Ton
306.36	Stone for Reclaimed Stabilized Base	Ton

**Pay items and units (English):**

306.106	Reclaimed Stabilized Base Processed in Place, 6 in Deep (F)	Square Yard
306.108	Reclaimed Stabilized Base Processed in Place, 8 in Deep (F)	Square Yard
306.110	Reclaimed Stabilized Base Processed in Place, 10 in Deep (F)	Square Yard
306.206	Reclaimed Stabilized Base Removed and Rehandled, 6 in Deep (F)	Square Yard
306.208	Reclaimed Stabilized Base Removed and Rehandled, 8 in Deep (F)	Square Yard
306.210	Reclaimed Stabilized Base Removed and Rehandled, 10 in Deep (F)	Square Yard
306.31	Asphalt For Reclaimed Stabilized Base	Pound
306.32	Asphalt For Reclaimed Stabilized Base	Ton
306.36	Stone for Reclaimed Stabilized Base	Ton